Bright Ideas: Winning Teams and Innovative Technologies from the 2005 Solar Decathlon (Testimony provided to the U.S. House of Representatives' Science Committee, Subcommittee on Energy on Wednesday, November 2, 2005 by Robert Schubert, Associate Dean for Research and Outreach, College of Architecture and Urban Studies, Virginia Tech accompanied by Robert Dunay, Chair, Industrial Design Program and Joseph Wheeler, Lead Faculty Advisor, Solar Decathlon Project)

The Virginia Tech Solar House

The Solar Decathlon of 2002 was an educational watershed challenging the relation between academia and practice and between research and its corresponding contribution to society. The knowledge derived from the 2002 competition has been integrated into the Virginia Tech house of 2005 to produce a work that combines innovative technology and daily life styles. This new project has achieved a high level of complexity expressed in an elegant simplicity. The initial theme of the *art of integration* has been realized through a design of a solar house that demonstrates a comfortable living and working environment, excellence in sustainable construction, and strong architectonic expression. The project presents forms that look to the future embodied with a sense of the sustainable and the beautiful.

Mission

The mission of the Virginia Tech Solar Decathlon Team is to inform and educate the public about issues of energy (particularly solar) and to give students energy expertise through a design-build process of innovative research and testing through application.

Our multidisciplinary team strives to achieve the following goals:

- **To illustrate how solar energy can improve the quality of life. Solar energy is clean; it significantly reduces pollutant emissions; and solar energy is renewable, thereby increasing our nation's energy security.**
- To make the public aware of how energy is used in their daily lives, and to illustrate the energy consumption of daily activities.
- To demonstrate that market-ready technologies exist that can meet the energy requirements of our daily activities by tapping into the sun's power.
- To demonstrate that sustainable materials and technologies can comprise a beautiful structure in which to live, work, and play.
- To examine a project in a prototypical manner to develop solutions that can be reproduced and realized through manufacturing techniques with economic benefit
- To challenge conventional practice through interdisciplinary collaboration and corporate partnerships

Beginning of Oral Presentation of Questions to be Addressed in the Testimony

Before we address the specific questions provided, we would like to acquaint you with some of aspects of our building produced for the 2005 Solar Decathlon competition.

The Virginia Tech Solar house integrates technology and architecture. The house achieved a balance between the two as reflected by winning the juried competition elements of Architecture, Dwelling, Daylighting and tying for first place in electric lighting.

Some of the key features include:

- ***efficient plan*** - The house is comprised of a small (580 sq. ft.) *rectangular plan* wrapped on three sides with a *translucent skin* and covered with a hovering curved *roof* inclined toward the sun.
- ***floating roof*** - The particular shape of the roof, a lightweight stressed skin, folded-plate filled with foam insulation, is designed to set the solar panels at an optimum angle for energy collection and integrate the panels into the roof form.
- ***north core module*** - A thick linear core defines a massive north wall and houses the batteries, electrical and mechanical equipment, and service functions such as the kitchen, laundry, storage, and closets. Constructed of expanded polystyrene panels that are lightweight, easily assembled, and yield a high insulation value, this module could be manufactured separately and utilized in many applications.
- ***translucent wall assembly*** – Two layers of aerogel filled polycarbonate panels transmit beautiful diffuse light while delivering an extremely high insulation value. There will be no need for electric lights from sunrise to sunset.
- ***tunable walls*** - Between the polycarbonate panels are three systems. A pair of reflective and absorptive motorized shades allow user control of light and heat transmission; linear actuated vents top and bottom provide ventilation for further thermal control; and, dimmer controlled LED lights allow the user to make the wall any color, no paint required.
- ***innovative engineered systems*** – our energy efficient ground source heat pumps powered by the solar electric panels provide environmental conditioning in the form of heating and cooling while delivering heat through a radiant floor that offers the best in terms of efficiency and quality. There is little air noise or movement and the ambient temperature can be kept lower saving energy.
- ***transportation*** – A lowboy chassis serving as the floor and foundation structure was designed to receive a detachable gooseneck and rear axels for transport. A truss on each side of the 48’ span resists deflection while in transit and rotates down 90 degrees to create a deck surrounding the house when stationary.

In response to the specific questions:

1. *Some of the main technical and other barriers to greater use of solar energy are:*
    - Inertia of public perception towards the status quo
    - Perception of increased complexity of new system vs. conventional systems
    - Conservatism of building industry and their adversity to risk
    - Cost – time of return on investment
    - There are few new architectural ideas relative to new technology

Some suggestions for what might be done to overcome those barrier are:

- Increased incentives for solar installations such as tax and mortgage incentives, low interest loans, and utility credits
- Create a National Awards Program for solar design
- Encourage numerous and repetitive small-scale applications
- Regional centers that promote the use of solar energy (similar to agricultural extension programs) working in conjunction with state energy offices
- Require utilities to generate a percentage of power from solar energy
- Federal energy subsidies redirected to encourage a higher percentage of renewable energy
- In addition to a week-long competition on the Mall, re-create the solar village for a longer period in an Expo type of forum

The Solar Decathlon Competition is an effective means to seed the potentials of solar energy in the public consciousness.

- It touches people from all walks of life and from diverse economic and social backgrounds. As witnessed in the competition of 2002 and 2005, there is widespread and growing public interest in solar energy. Integral with the competition, all aspects of the house are considered with respect to conservation of energy. Particularly the Virginia Tech house, demonstration was made that a solar dwelling can offer a desirable and rich lifestyle.

- Its competitive content activates top research universities to further their research efforts and to draw unique collaborations with industry. The competition allows partnerships to be formed. Among many corporations, Virginia Tech worked with GE Specialty Film and Sheet and Cabot Corporation to produce a wall that delivers great light and high insulation. Likewise, collaboration with California Closets has the corporation, for the first time, building cabinet prototypes from a Dow Chemical wheat board that is sustainable and non detrimental to the environment.

2. The Solar Decathlon of 2002 provided a wealth of information in our own experience of designing and building a house as well as observing the houses from other research institutions.

- Our 2005 house integrates the research from the previous work and lessons learned from other houses.
- In addition to on campus expertise, a network of manufacturers and professionals having ties to Virginia Tech was used to develop and refine ideas.
- A student network researched a wide range of materials, processes and technologies, some of which were integrated into our design.
- The United States Green Building Council's (USGBC) draft LEED Residential program provides us with an outline to reduce indoor air pollutants, minimize global warming, reduce waste, include recycled content, represent low embodied energy in manufacture and harvest, limit destruction to habitat, and rapidly renew.

Two of the problems we encountered were:

- An inordinate amount of time, energy and cost associated with our transportation strategy
- Percentage of time utilized to raise in-kind donations and extreme difficulty in raising cash contributions

3. Our house would be commercially viable:

- Placed within the context of commercially manufactured housing.
- Winning the Architecture and Dwelling Awards in the competition, the Virginia Tech house demonstrated its appeal to a discriminating set of judges.
- The Virginia Tech Solar House offers various possibilities for components that will conserve energy and improve the quality of residential building.

In conclusion, we would like to leave with this final thought:

We approach a watershed. Our lifetime has experienced an increased dependence on technology. Almost every amenity we enjoy is dependent upon centralized systems whose working and control are far removed from localized areas. A short curtailment of services sends neighborhoods and regions into temporary states of chaos. In the recent case of hurricane damage, available supplies of gasoline could not be accessed due to lack of electrical service. Whether from natural disaster or terrorist threat, large-scale technologies have exposed growing risks. We must reduce the risk of widespread technological failure by providing alternative distributed power solutions and backing up centralized systems with *grass roots* capability of generating power. With continued support and research of solar energy, this vision is achievable for the next generation.